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ABSTRACT

The general purpose of the occupational analysis is to provide workable, basic information dealing with the many and varied duties performed in the turf specialists occupation. The document opens with a brief introduction followed by a job description. The bulk of the document is presented in table form. Four duties are broken down into a number of tasks and for each task a able is presented, showing: tools, equipment, materials, objects acted upon; performance knowledge (related also to decisions, cues and errors); safety--hazard; science; math--number systems; and communications. The duties include: planting, growing, and maintaining turf for permanent cover and for sod production; selling sod; and maintaining tools, equipment, and structures. Appended is an outline of basic arithmetic skills and concepts needed. (BP)

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Occupational Analysis

CE 004202

TURF SPECIALIST

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5152

AN ANALYSIS OF THE TURF SPECIALIST OCCUPATION

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The Instructional Materials Laboratory
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The Ohio State University

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FOREWORD

The occupational analysis project was conducted by The Instructional Materials Laboratory, Trade and Industrial Education, The Ohio State University in conjunction with the State Department of Education, Division of Vocational Education pursuant to a grant from the U.S. Office of Education.

The Occupational Analysis project was proposed and conducted to train vocational educators in the techniques of making a comprehensive occupational analysis. Instructors were selected from Agriculture, Business, Distributive, Home Economics, and Trade and Industrial Education to gain experience in developing analysis documents for sixty-one different occupations. Representatives from Business, Industry, Medicine, and Education were involved with the vocational instructors in conducting the analysis process.

The project was conducted in three phases. Phase one invoived the planning and development of the project strategies. The analysis process was based on sound principles of learning and behavior. Phase two was the identification, selection and orientation of all participants. The training and workshop sessions constituted the third phase. Two-week workshops were held during which teams of vocational instructors conducted an analysis of the occupations in which they had employment experience. The instructors were assisted by both occupational consultants and subject matter specialists.

The project resulted in producing one hundred two trained vocational instructors capable of condulting and assisting in a comprehensive analysis of various occupations. Occupational analysis data were generated for sixty-one occupations. The analysis inlcuded a statement of the various tasks performed in each occupation. For each task the following items were identified: tools and equipment; procedural knowledge; safety knowledge; concepts and skills of mathematics, science and communication needed for successful performance in the occupation. The analysis data provided a basis for generating instructional materials, course outlines, student performance objectives, criterion measures, as well as identifying specific supporting skills and knowledge in the academic subject areas.

PREFACE

This occupational analysis covers those general duties and tasks involving the planting, raising and caring for sod and turf. A turf specialist may be involved in very specialized operations such as caring for the turf on a golf course, lawn tennis court or other recreation area: or be involved in raising turf for private lawns, public areas, or other contracted areas. This analysis takes a more general approach, covering basic duties and tasks performed by most turf specialists. A small number of specialized tasks are included, but no supervisory tasks are included.

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JOB DESCRIPTION

The turf specialist must be able to perform all duties connected with establishing, installing, maintaining, producing or selling turfgrass. The turf specialist must have a basic knowledge of soil properties and characteristics; turfgrass classification, anatomy, physiology and pathology; and must be able to design turf areas according to intended use. The turf specialist must be able to supervise operations such as turf establishment, maintenance and sales. Ultimately the turf specialist should have insight into the problems of management, such as labor management, records, inventory and planning future business expansion and operations.

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Duty A Planting and Growing Turf for Permanent Cover and for Sod Production

1 Measure area and mark boundaries
2 Remove unwanted trees and obstacles
3 Design turf areas
4 Install drainage systems
5 Install water and irrigation systems
6 Apply top soil and establish grades
7 Test soil
8 Prepare soil for seed or sod
9 Sterilize soil
10 Apply fertilizer or lime
11 Apply seed or sod
12 Mulch and water seed bed
13 Care for new seedings or sod
14 Identify and improve physical features of soil
15 Test soil and improve soil fertility
16 Locate sources and determine availability of commercial fertilizers

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(TASK STATEMENT) MEASURE AREAS AND MARK BOUNDARIES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Measuring tape Measuring wheel Marking stakes, driving hammer Drawing paper Pencils Conversion tables for measurements of length, area and volume	Use measuring tape to measure length and widths Use measuring wheel to measure length and widths Figure square feet, yards Post measurements in logical sequence	

DECISIONS	CUES	ERRORS
Implied–application of procedure		Incorrect marking

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
	Basic Arithmetic Skills and Concepts (see appendix) Measures of length Determination of areas	Write measurements in logical order

(TASK STATEMENT) REMOVE UNWANTED TREES AND OBSTACLES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Tree saws
Chain saw
Shovel
Axe
Tractor with front end loader and back hoe
Truck
Tree harness
Tree rope

PERFORMANCE KNOWLEDGE

Cut tree with hand and power chain saws
Cut root system with axe
Load cut wood into truck
Operate tractor with front end loader and back hoe
Climb and prune trees

SAFETY – HAZARD

Hazards:
- Injury from saws, shovel or axe
- Injury from tractor, equipment or truck
- Injury from falling debris

Safety precautions:
- Wear protective clothing, hard hats and goggles
- Do not operate equipment when people are near
- Stand safely back from trees and equipment

DECISIONS

Determine which to remove
Determine how to remove

CUES

Aesthetics; logic
Size; location; type of object

ERRORS

Removal of wrong object
Injury to objects other than that being removed

SCIENCE

Simple machines used to gain mechanical advantage [understand leverage]

Inertia and momentum (body at rest and body in motion) [falling trees]

MATH – NUMBER SYSTEMS

COMMUNICATIONS

Mark on a map where underground objects may be hidden

(TASK STATEMENT) DESIGN TURF AREAS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Drawing paper
Drawing pencils and pens
T-square
Drawing board
Eraser
Blueprints
Blueprint

PERFORMANCE KNOWLEDGE

Design facilities as needed for demand of golf and other games played on turf
Make landscape drawings according to various scales
Write specifications for drainage systems, water lines, electrical lines, sewer lines and golf greens
Make topographical maps showing elevations

SAFETY – HAZARD

DECISIONS	CUES	ERRORS
Determine facilities needed	Effect of play on grass Rules of game	Inefficient design

SCIENCE

Effect of heating and cooling on expansion of materials (change of dimensions)

Form, balance, scale, proportion, contrast, unity

MATH – NUMBER SYSTEMS

Basic Arithmetic Skills and Concepts (see appendix)
Basic Measurement Skills and Concepts (see appendix)

Understanding and use of the Pythagorean theorem, based on the right triangle ($a^2 + b^2 = c^2$)
Use of formula to determine the area of a circle
Determination of area of triangels
Determination of area, perimeter and diagonals of polygons with more than four sides
Determination of area, perimeter and diagonals of quadrilaterals
Determination of area and circumference of circles
Use of arcs or chords in determining facts about a circle or its parts
Determination of the area of rings
Determination of facts involving sectors of a circle
Determination of areas and perimeter of an ellipse
Determination of facts involving lines tangent to circles
Determination of altitude, area and volume of a right circular cone
Determination of lateral area, total area and volume of frustums of pyramids and cones
Determination of the surface and volume of a sphere
Geometric constructions
Read and interpret tables, charts and/or graphs
Measure with the Metric and English system and convert between them

COMMUNICATIONS

Write specifications for items described under performance knowledge

Draw landscape plans

(TASK STATEMENT) INSTALL DRAINAGE SYSTEMS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Transit
Tile (plastic, clay, etc.)
Trenching machine
Ditching equipment
Gravel
Tile joint covers
Tile outlets
Landscape plans, drawings of drainage system

PERFORMANCE KNOWLEDGE

Determine the drainage practices used for different types of turf areas
Prescribe system of tile line arrangement
Identify kind of tile used for drainage
Analyze soil and slope for drainage problems
Use transit for drainage layout
Read designs for drainage system
Operate trenching and ditching equipment
Lay tile into trenches

SAFETY – HAZARD

Hazards:
Danger to persons working with digging equipment
Laying tile irregularly so as to cause water stoppage and tile breaks
Safety precautions:
Avoid getting overly near digging equipment

DECISIONS	CUES	ERRORS
Determine tile layout	Type of turf, soil, tile, drainage problems	Inefficient design

SCIENCE

Water flow rates according to slope
Effect of heating and cooling on expansion of materials (change of dimensions)
Effect of heating and cooling on state of matter (change of matter from one form to another)

MATH – NUMBER SYSTEMS

Basic Arithmetic Skills and Concepts (see appendix)
Basic Measurement Skills and Concepts (see appendix)

COMMUNICATIONS

Read engineering specifications and water flow charts

(TASK STATEMENT) INSTALL WATER AND IRRIGATION SYSTEMS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Transit
Water pipe and connectors
Trenching machine
Time clocks

PERFORMANCE KNOWLEDGE

Select proper kinds of irrigation pipe, connectors and nozzles
Use transit for irrigation line layout
Read designs for irrigation system
Operate trenching equipment
Lay water lines and install connectors and nozzles
Check water system for drainage
Assemble automatic electrical system

SAFETY – HAZARD

Hazards:
Dangers to people working with digging equipment
Laying irrigation pipe irregularly so as not to drain properly
Safety precautions:
Avoid close contact with irrigation equipment

DECISIONS	CUES	ERRORS
Implied–application of procedure Determine proper irrigation system	Type of turf, equipment, soil, climate conditions	Inefficient design

SCIENCE

Water flow rates in various size pipes
Effect of heating and cooling on expansion of materials (change of dimensions)
Effect of heating and cooling on state of matter (change of matter from one form to another)

MATH – NUMBER SYSTEMS

Basic Arithmetic Skills and Concepts (see appendix)
Basic Measurement Skills and Concepts (see appendix)
Read and interpret tables, charts and/or graphs

COMMUNICATIONS

Read specifications for water flow and electrical circuitry

(TASK STATEMENT) APPLY TOP SOIL AND ESTABLISH GRADES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Top soil Truck Tractor with blade	Drive dumptruck to haul soil Operate tractor with grader blade to establish grade	Potential danger with dumptruck, tractor and blade

DECISIONS	CUES	ERRORS
Decide where to apply topsoil	Terrain needs plant needs; future needs	Poor soil quality Poor growth conditions

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Knowledge of good topsoil composition	Volumetric measurement of soil needed on a given area	Viewing slopes

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(TASK STATEMENT) TEST SOIL

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Sudsbury or Simplex soil test kit Soil sampling tube Soil sampling bags or containers Kiln drier (optional)	Take soil samples Prepare soil samples for testing Test soil for soil reaction Test soil for major nutrients Test soil for percolation Test soil for soil texture Clean and store soil test equipment	Hazards: Skin burns from soil test materials Safety precautions: Wear rubber gloves when working with caustic chemicals

DECISIONS	CUES	ERRORS
Determine need for a soil test	Growth of plants, soil condition observation, time for test (pre-determin...	Poor quality soil Poor plant growth Erosion and waste of topsoil

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Understand solubility of nutrients in water Understand soil acidity or alkalinity	Measures of length Measure of time and speed. (Example: time-seconds, minutes, etc.; speed-feet per minute, R.P.M., etc.) Measures of temperature Liquid and dry measures	Write soil test results on a record sheet

(TASK STATEMENT) PREPARE SOIL FOR SEED OR SOD

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Tractor with following equipment:
- Grader blade
- Plow
- Disk–pulverizer
- Harrow
- Roto-tiller
- Float or drag
- Rake

Hand tools needed:
- Shovel
- Rake
- Sod spade

Small equipment:
- Roto-tiller
- Disk or culivator

PERFORMANCE KNOWLEDGE

Remove weeds or existing sod (if needed)
Clean and rake soil surface if overseeding
Plow or roto-till soil
Disk and pulverize soil surface
Rake to remove rocks and debris
Level soil with blade
Smooth soil with float or drag
Clean and store equipment after use

DECISIONS

Implied–application of procedure

CUES

ERRORS

Poor plant growth
Incorrect preparation
Erosion

SAFETY - HAZARD

Hazards
- Injury from tractor and equipment such as disk or roto-tiller

Safety precautions
- Disengage power train before servicing roto-tiller or other moving equipment
- Wear goggles and protective clothing
- Do not smoke near gasoline engines

SCIENCE

Understand need for pulverization of soil before seeding

Understand problem of compaction on "heavy" soils

Work input, work output, friction and efficiency in simple machines

MATH – NUMBER SYSTEMS

Measures of length
Measure of weight

COMMUNICATIONS

Read operating instructions on equipment before using

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(TASK STATEMENT) STERILIZE SOIL

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Soil sterilant chemicals
Plastic cover
Anchor stakes for plastic
Steam sterilization equipment (used for small laboratory work only)

PERFORMANCE KNOWLEDGE

Select proper method of soil sterilization
Install protective cover
Apply soil sterilizing material
Clean and store soil sterilization equipment

SAFETY – HAZARD

Hazards:
Skin burns or inhalation injury from chemicals
Stomach injury if ingested
Safety precautions:
Wear rubber gloves and respirator if required by chemical
Do not remove covers until after safe removal time
Do not plant grass seed until after recommended time

DECISIONS	CUES	ERRORS
Determine need for soil sterilization Select proper method of soil sterilization	Growth of plants, soil condition observation; time for test (pre-determined) Area or amount of soil to be sterilized Use of soil	Poor quality soil Poor plant growth Erosion and waste of top soil

SCIENCE

Gas movement within soil
Principle of sterilization when chemical is in soil solution

MATH – NUMBER SYSTEMS

Measure of temperature
Measurement, liquid and dry
Measure of weight
Ratio and proportion

COMMUNICATIONS

Write records on what technique and time schedule used for administering soil sterilization

(TASK STATEMENT) APPLY FERTILIZER OR LIME

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Tractor with the following equipment:
- Fertilizer spreader, 2-wheel
- Harrow
- Drag or float

Hand equipment:
- Rake
- Cyclone-type fertilizer spreader
- Two-wheel fertilizer spreader

PERFORMANCE KNOWLEDGE

Interpret results of soil test
Apply fertilizer or lime
Work into soil with harrow
Drag or float soil in preparation for seeding
Clean and store equipment and materials

SAFETY – HAZARD

Hazards:
- Fertilizer burn to skin, eyes or stomach
- Injury from tractor or equipment

Safety precautions:
- Use protective clothing and goggles when applying fertilizers
- Disengage equipment before servicing

DECISIONS	CUES	ERRORS
Determine the need for fertilizer or lime	Soil observation, previous plant growth	Incorrect preparation Poor plant growth
Determine what kind of fertilizer or lime needed	Soil type; plant type; terrain; season, proposed soil use	Waste of time and money
Determine amount of fertilizer or lime needed	Soil needs; plant needs; weather; manufacturer's suggestions	

SCIENCE

Work input, work output, friction and efficiency in simple machines

Understand the need for fertilizer or lime in new seeding or sodding

Understand the proximity of lime and fertilizer materials to seed within seedbed

MATH – NUMBER SYSTEMS

Measures of length

Liquid and dry measures

Calculate amount of material need per unit area

Able to adjust equipment spreading according to need

Ratio and proportion

Measures of weight

COMMUNICATIONS

Record amounts of lime or fertilizer applied to a given area

Read labels three times before using materials

(TASK STATEMENT) APPLY SEED OR SOD

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Tractor with the following equipment:
- Seeder, two-wheel
- Seeder, cyclone-type
- Wagon
- Rake
- Stolonizing or hydrofoam equipment (optional)

Hand tools or equipment
- Two-wheel seeder
- Cyclone-type seeder
- Rake

Materials
- Grass seed
- Sod, plugs, sprigs or stolens

PERFORMANCE KNOWLEDGE

Apply seed to seed bed uniformly
Lay sod
Apply plugs, twigs or stolens
Rake seedbed lightly after seeding
Clean and store equipment and materials

SAFETY – HAZARD

Hazards:
- Injury due to tractor or equipment

Safety precautions:
- Do not service equipment when in operation
- Do not smoke around motorized equipment

DECISIONS	CUES	ERRORS
Select proper seed or sod	Seed or sod requirements, proposed use of grass space, soil condition, growth condition and period, weather, season	Incorrect application Poor growth Unsightly High weed concentration
Determine amount of seed needed per unit area or spacing between plugs, twigs or stolens	Type of seed, type of soil, soil condition, growth period, manufacturer's suggestions	

SCIENCE

Work input, work output, friction and efficiency in simple machines

Principle of seed contact with soil

MATH – NUMBER SYSTEMS

Measures of length

Liquid and dry measures

Measure of weight

Ratio and proportion

COMMUNICATIONS

Read seed labels before figuring application rates

Record amounts of seed, plugs, stolens, etc., applied per unit area

(TASK STATEMENT) MULCH AND WATER SEED BED

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Tractor
Wagon
Water tank
Watering hose
Watering nozzles and connectors
Mulches
Roller (tractor or hand)
Rake

PERFORMANCE KNOWLEDGE

Determine germination time for various seed types
Apply mulch to seed bed
Rake mulch evenly
Roll mulched seed bed
Water thouroughly
Clean and store equipment

SAFETY - HAZARD

Hazards:
Injury due to tractor or equipment
Safety precautions:
Do not service equipment when in operation
Do not smoke around motorized equipment

DECISIONS	CUES	ERRORS
Select type of mulch needed Determine amount of mulch to be applied Determine rate and frequency of water to be applied	Soil type, plant needs Soil needs, plant needs Soil needs, plant needs; weather, season	Incorrect preparation Poor quality plants

SCIENCE

Work input, work output, friciton and efficiency in simple machines

Fluids under pressure

Principle of water force on soil surface (use fine distribution nozzle when watering)

MATH - NUMBER SYSTEMS

Measures of length

Liquid and dry measures

Determination of area and volume of rectangular, cube and right triangular prisms

Ratio and proportion

COMMUNICATIONS

Record amount of mulch applied

Record rate, frequency and duration of water applied

(TASK STATEMENT) CARE FOR NEW SEEDLINGS OR SOD

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Tractor or hand mowers Watering hose, tanks and nozzles Watering gauge	Water turf grass according to need Mow new seedlings or sod three or four times before turf grass "maintenance" program begins	Hazards: Danger from tractor and mowing equipment Applicaton of weed killers too early Mowing new seedlings when soil is too wet Safety precautions: Use safety clothing when operating mowers Do not dig weeds or apply herbicide before four mowings

DECISIONS	CUES	ERRORS
Determine frequency, rate and duration of watering for new turf grass Determine mowing height and time to mow new seedlings or sod	Soil type, plant needs Soil needs: plant needs, weather, season	Poor quality sod Death of seedlings

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Work input, work output, friction and efficiency in simple machines Development of root and shoot of growing grass plant	Liquid and dry measures Read and interprct tables, charts and/or graphs	Record watering rate, frequency and duration of new seedlings or soil Record times of mowing

(TASK STATEMENT) IDENTIFY AND IMPROVE PHYSICAL FEATURES OF SOIL

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Test tubes Petrie dishes Soil amendment materials: Peat moss Manure Sludge Sand Calcined clay Gypsum Miscellaneous other materials Soil sampling tube	Identify components of soil Apply materials to soils to improve tilth	

DECISIONS	CUES	ERRORS
Determine soil type, texture and structure (soil judging) Determine means of improving soil structure	Observe soil conditions, compare with other known types Analyze corrective measures available	Poor quality soil Poor growth

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Physical and chemical properties of soil: Air Water Organic matter Mineral matter	Liquid and dry measures Read and interpret tables, charts and/or graphs	Read recommendations for improving soil on the basis of soil judging Be able to judge soil and recommend improvement practices

(TASK STATEMENT) TEST SOIL AND IMPROVE SOIL FERTILITY

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Soil test kit Fertilizers and lime	Conduct soil test for: pH, nitrogen, phosphorus, sulfur, potassium, calcium, magnesium, iron Recommend fertilizer or lime to be used to improve fertility of pH level based on soil test Apply needed fertilizer or lime Clean and store chemicals and equipment	Hazard: Chemical burn from soil test chemicals or fertilizers Safety precautions: Use protective clothes when working with chemicals

DECISIONS	CUES	ERRORS
Implied–application of prior knowledge		Poor plant growth Poor plant health Unsuitable soil

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Availability of nutrients in the soil solution Understand pH and how it can be altered	Logarithms Measures of temperature Liquid and dry measures	Summarize soil test results and list fertilizer or lime amendments to improve fertility or pH

(TASK STATEMENT) LOCATE SOURCES AND DETERMINE AVAILABILITY OF COMMERCIAL FERTILIZERS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Paper Pencils Calculating machine	Identify forms of commercially available fertilizers and lime Identify companies which manufacture, supply or distribute fertilizers and lime	

DECISIONS	CUES	ERRORS
Determine cost and availability of local fertilizers or lime Decide which products cost least and insure best results	Correspondence with manufacturers and competitors Manufacturer's suggestions, supplier suggestions, previous results	Poor soil quality Poor plant growth Inefficient use of time and money

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
	Basic Arithmetic Skills and Concepts (see appendix) Basic Measurement Skills and Concepts (see appendix) Determine cost per unit volume or type of analysis of fertilizer	Write list of companies, fertilizers and fertilizer costs which would lead to proper decision when ordering fertilizers

Duty B Maintaining Turf for Permanent Cover and Sod Production

1 Fertilize and lime turf grass
2 Mow turf grass
3 Irrigate turf grass
4 Aerate turf area
5 Remove thatch from turf
6 Pole and brush golf course greens
7 Renovate turf
8 Control weeds in turf
9 Control turf diseases
10 Control insects and other pests in turf
11 Prune trees and shrubs on golf course

(TASK STATEMENT) FERTILIZE AND LIME TURF GRASS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Types of fertilizer
Types of lime
Dry fertilizer spreader–2-wheel
Dry fertilizer spreader–cyclone type
Liquid fertilizer proportioner
Dry fertilizer mixer
Measuring tape
Mixing buckets or devices

PERFORMANCE KNOWLEDGE

Test soil
Select proper types of fertilizer applicators
Measure area to be fertilized
Interpret rates of fertilizer application
Apply fertilizer
Adjust fertilizer applicators to apply determined rate of application
Clean and store equipment and materials after use

SAFETY – HAZARD

Hazards:
- Chemical burn from fertilizer
- Using dull equipment

Safety precautions:
- Use safety eye glasses
- Use rubber gloves
- Read label three times
- Avoid fertilizer contact with skin
- Sharpen equipment properly

DECISIONS	CUES	ERRORS
Select forms of commercially available nutrients Determine quantity of fertilizer to be applied Determine method of application	Soil requirements, plant requirements, ease of application Type of fertilizer, soil requirements, plant requirements Type of fertilizer, manufacturers' recommendation, soil terrain	Wrong type fertilizer applied Too much or too little fertilizer used Unnecessary application Waste of time and money

SCIENCE

Composition of matter, including protons, neutrons, electrons, atoms, molecules, elements
[composition of chemical compounds involving nutrients]

Read and interpret tables, charts and graphs
[interpret fertilizer analysis]

Recognize fertilizer deficiency or excess

Solubility of chemicals

Identify and describe major and minor nutrients

List functions of nutrients in plants

MATH – NUMBER SYSTEMS

Basic Arithmetic Skills and Concepts (see appendix)

Measures of length
Measures of time and speed. (Example: time-seconds, minutes, etc.; speed-feet per minutes, R.P.M., etc.)
Measures of weight
Measures of temperature
Liquid and dry measures
Use of formula to determine the area of a circle
Determination of area of triangles
Determination of area, perimeter and diagonals of polygons with more than four sides
Determination of area and circumference of circles
Figure:
- Area of turf needing fertilization
- Amount of active nutrients in pounds available from commercial farms
- Application rates based on percent of active ingredient used
- Machine settings to accomplish desired distribution rates

COMMUNICATIONS

Read fertilizer formulas and tables

Read orders for application rates from the supervisor

(TASK STATEMENT) MOW TURF GRASS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Rotary hand mower
Reel hand mower
Reel greens mower
Verticut mower
Tractor-drawn rotary mower
Tractor-drawn gang reel mowers
Mower blade sharpeners (reel and rotary)
Lawn sweeper
Measuring ruler

PERFORMANCE KNOWLEDGE

Measure grass height with ruler
Understand operation of power source, power train and mowing technique
Service mowing equipment before starting
Start mower and make running adjustments
Vary direction of cut according to turf variety and use
Clean and store mowing equipment

SAFETY - HAZARD

Hazards: Vertical, rotary or reel type blades
Potentially volatile materials (gasoline, oil and brake fluid)
Safety precautions: Use safety goggles
Insure placement of shields and guards
Never service machines while running
Operate machines at safe speed
Sharpen blades properly
Adjust blades properly
Avoid smoking around machines

DECISIONS	CUES	ERRORS
Determine frequency of mowing various turf varieties Determine mowing heights of specific turf varieties	Type of turf, proposed turf uses, weather and growing conditions	Unsightly end turf product Growth unstable

SCIENCE

Simple machines used to gain mechanical advantage

Centrifugal forces developed by bodies in rotation

Understand:
- Physiology of grass plant
- Cutting action of reel vs. rotary blades
- Difference between two-cycle and four-cycle engines
- Fuel mixtures for two-cycle eingines
- Basic transmission systems
- Leverage
- Controls

Inertia and momentum (body at rest and body in motion)

MATH - NUMBER SYSTEMS

Basic Arithmetic Skills and Concepts (see appendix)

Measures of length
Measures of time and speed
Measures of weight
Measures of temperature
Liquid and dry measures
Development of graphs comparing two complimentary sets of figures
Use of fractions and decimals in figuring height of cut and frequency of cut
Compute amounts of fertilizer in a source and amount of fertilizer to be applied

COMMUNICATIONS

Read: Directions for machine operation
Turf mowing specifications

(TASK STATEMENT) IRRIGATE TURF GRASS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Irrigation nozzles, valves, connectors and distributors
Irrigation hose and various pipes
Underground irrigation system
Irrigation water
Time clock
Electrical system for automatic watering

PERFORMANCE KNOWLEDGE

Test composition of water
Calculate waterstress on turf types and determine amount of water needed
Calculate and apply fertilizer or other chemicals in water
Apply water by hand
Apply water automatically (adjust automatic system)
Lubricate and maintain irrigation equipment

SAFETY - HAZARD

Hazard: Whip action of high pressure lines
Water pressure directed toward vulnerable human organs
Drinking treated irrigation water
Safety precautions: Secure high pressure hoses tightly
Do not direct water flow toward people
Avoid drinking treated water

DECISIONS	CUES	ERRORS
Select proper watering device	Area to be watered, availability of watering equipment, weather conditions, type of turf	Poor end product
Determine frequency of watering	Weather conditions, soil needs, plant needs, time and equipment availability	Waste of time and equipment

SCIENCE

Principles of water flow and pressure
Transpiration principle
Evaporation principle
Electrical circuitry
Water solubility of chemicals
Physical characteristics of plastic, metal or flexible pipe or hose
Mechanical action of basic watering nozzles and devices
Principles of water flow and the pressure

MATH - NUMBER SYSTEMS

Basic Arithmetic Skills and Concepts (see appendix)

Measures of length
Measures of time and speed
Measures of temperature
Measures of weight
Liquid and dry measures
Use of formula to determine the area of a circle
Determination of area and circumference of circles
Calculate:
- Water flow rates (g.p.m.)
- Fertilizer proportions in water lines
- Measuring amount of water applied
- Measure depth of water penetration

COMMUNICATIONS

Read water flow rate charts
Read fertilizer labels and tables

(TASK STATEMENT) AERATE TURF AREAS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Mechanical aerifiers–plugging type, slicing type, spiking type
Dethatching machine
Thatch
Hand aerifiers
Roller
Plug spreader (drag)

PERFORMANCE KNOWLEDGE

Analyze the problems of soil compaction, thatch build-up and lack of soil oxygen
Service and start dethatching, and aerifying equipment
Operate dethatching and aerifying equipment
Operate sod plug roller and spreader equipment
Clean and store equipment

SAFETY – HAZARD

Hazard:
Cutting hands or feet with equipment
Combustion of flammable materials
Safety precautions:
Use safety toe shoes
No smoking around equipment

DECISIONS	CUES	ERRORS
Determine type of equipment to use	Area to be aeriated, availability of equipment; weather conditions, type of turf	Poor end product
Determine frequency of application	Weather conditions; soil needs; plant needs; time and equipment availability	Waste of time and equipment

SCIENCE

Simple machines used to gain mechanical advantage [within mechanical aerator]

Relationship of soil compaction to aeration, percolation of water in soil and root growth

MATH – NUMBER SYSTEMS

Measure of time and speed

Reach and interpret charts, tables and/or graphs [machine adjustments]

COMMUNICATIONS

Read instructions on machine operation

(TASK STATEMENT) REMOVE THATCH FROM TURF

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Vertical mower Power rake Power grass sweeper Hand rake	Top dress with soil for simple cases Identify causes of thatch accumulation Service and start dethatching equipment (vertical mower) Operate vertical mower Operate hand rake Operate hand or power lawn sweeper Clean and store equipment	Hazard: Danger of vertical mower blades Explosion of volatile materials Safety precautions: Wear safety shoes Never service machine while running Do not smoke around machine

DECISIONS	CUES	ERRORS
Determine the need for thatch removal	Soil requirements; plant requirements	Poor end product
Determine type of equipment to use	Area to be dethatched; availability of equipment; weather conditions; type of turf	Waste of time and equipment
Determine frequency of dethatching	Weather conditions; soil needs; plant needs; time and equipment availability	

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Principles of biological decay of organic matter Physical reasons for thatch accumulation Principle of vertical rotating blades in removing thatch with a vertical mower	Measure of time and speed (determine job time) Read and interpret tables, charts and/or graphs	Read chart on machine operation

(TASK STATEMENT) POLE AND BRUSH GOLF COURSE GREENS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Flexible bamboo or steel pole Brush type sweeper	Operate drag or pole in smoothing bentgrass greens Operate hand or power sweeper in smoothing bentgrass greens	Hazards: Injury from pole or sweeper Combustion of volatile materials Safety precautions: Do not smoke Stand clear of equipment when in operation

DECISIONS	CUES	ERRORS
Determine frequency of operation	Weather conditions, soil needs; plant needs, time and equipment availability	Unsightly greens Harm to plants Waste of time and money

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Reason for worn castings on surface of bentgrass greens Principle of rolling or sweeping action in smoothing the green		Read instructions from supervisor

(TASK STATEMENT) RENOVATE TURF

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Fertilizer applicator
Aerifier
Dethatcher (vertical mower)
Seeder (rotary or two-wheel)
Mulches (peatmoss, straw, etc.)
Soil sampler
Soil testing equipment
Measuring tape
Fertilizer materials
Weed killers, insecticides or other pesticides
Rakes (hand or power)
Lawn sweeper

PERFORMANCE KNOWLEDGE

Analyze causes of poor turf
Apply weed killers
Mow turf areas closely
Mow with verticut mower if thatch is a problem
Rake severely with tine harrow or power rake
Remove all debris with sweeper
Apply lime and fertilizer (test soil first)
Sow grass seed; drag seed into seed bed; mulch seeding; water seedbed; apply sod, plugs or twigs
Clean and store equipment

SAFETY – HAZARD

- Hazards:
  - Danger to eyes and extremeties from power equipment
  - Danger of chemical injury from weed killers
- Safety precautions:
  - Wear eye goggles
  - Wear gloves
  - Stop equipment before servicing
  - Do not smoke around machines

DECISIONS	CUES	ERRORS
Decide when to do renovation	Sod condition, season, time and equipment available	Poor sod Unsightly Harm to sod Waste of time and money
Decide if drainage is needed	Sod condition; season, time and equipment available	

SCIENCE

Composition of matter, including protons, neutrons, electrons, atoms, molecules, elements
[composition of chemical nutrient compounds]

Read and interpret tables, charts and/or graphs
[interpret fertilizer analysis recognize fertilizer deficiency solubility of chemicals]

Simple machines used to gain mechanical advantage

Centrifugal forces developed by bodies in rotation

Intertia and momentum (body at rest and body in motion)

MATH – NUMBER SYSTEMS

Basic Arithmetic Skills and Concepts (see appendix)

Basic Measurement Skills and Concepts (see appendix)

Use of formula to determine the area of a circle

Determination of area of triangles

Determination of area, perimeter and diagonals of polygons with more than four sides

Determination of area and circumference of circles

Development of graphs comparing two complimentary sets of figures

Figure:
- Area of turf needing fertilization
- Amount of active nutrients in particular fertilizers
- Application rates based on active ingredient used
- Machine settings to accomplish desired distribution rates

COMMUNICATIONS

Read fertilizer labels

Read mixing directions for chemicals

Read directions for machine operations

(TASK STATEMENT) CONTROL WEEDS IN TURF

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Hand tools for weed removal
Dry herbicide applicators (2-wheel, cyclone type)
Liquid herbicide applicators (hand or power sprayers)
Herbicide materials such as 2-4D, etc.
Proportioners and nozzles for water hose end applicators
Safety equipment for protection

PERFORMANCE KNOWLEDGE

Identify weeds
Distinguish between annual and perennial weeds and the difference in mechanical or chemical control

Mix herbicide correctly for proper weed kill
Service, start and operate equipment
Apply weed killer for maximum effectiveness
Use handtools for mechanical removal of weeds
Clean and store equipment

SAFETY – HAZARD

Hazards: Chemical burn to skin or eyes
Improper application rate to result in damaging side effects
Danger of damage to other plants
Chemical drift in air or pollution of water or soil
Safety precautions: Read label three times
Use protective clothing or respirators
Apply only in "safe" areas
Avoid "haphazard" spray or application
See if chemical can be legally applied

DECISIONS	CUES	ERRORS
Determine herbicide type to be used	Analyze type of weed to kill; type of sod, type of soil	Poor turf quality
Select proper mechanical device for herbicide application	Type of herbicide used; manufacturers' suggested application; soil terrain, season of year	Waste of time and money
Determine when herbicide should be applied	Season; turf requirements, weed growth	Kill turf

SCIENCE

Fluids under pressure
Liquid and dry measures
[solubility and miscibility of dry and liquid measures]
Physiological action of weed killer on plants

MATH – NUMBER SYSTEMS

Basic Arithmetic Skills and Concepts (see appendix)
Basic Measurement Skills and Concepts (see appendix)
Determination of area, perimeter and diagonals of polygons with more than four sides
Determination of area, perimeter and diagonals of quadrilaterals (four-sided figures)
Determination of area and volume of cylinders
Read and interpret tables, charts and/or graphs
Given an Instrument of Measure, determine precision and/or accuracy with respect to relative error, significant digits and tolerance
Calculate:
Amount of chemical needed per unit volume of water
Amount of chemical needed per unit area to be cleaned

COMMUNICATIONS

Read herbicide labels
Read charts for herbicide rates of application

(TASK STATEMENT) CONTROL TURF DISEASES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Hand lens
Microscope
Dry pesticide applicators
Liquid pesticide applicators (hand sprayers, power sprayers)
Fungicides and bactericides
Proportioners and nozzles for hose-end applicators
Safety equipment for protection

PERFORMANCE KNOWLEDGE

Identify turf diseases
Distinguish between different disease symptoms

Select preventative disease measures and proper control measures (chemical or mechanical) for a specific disease

Select proper method of applying fungicide or bactericide
Select and apply proper seed treatment for preventative measures
Service, start and operate mechanical equipment
Clean and store equipment, store chemicals properly

SAFETY – HAZARD

Hazards: Chemical burn to skin or eyes
- Improper application rate or method resulting in damaging side effects
- Danger of damage to other plants
- Danger of drift in air or pollution of water or soil

Safety precautions: Read label three times
- Use protective clothing or respirators
- Apply only in "safe" areas
- Avoid haphazard spray or application
- See if chemical can be legally be applied

DECISIONS	CUES	ERRORS
Determine control to be used Select proper mechanical device for control application	Analyze type of disease, type of sod, type of soil Type of control used, manufacturers' suggested application, soil terrain, season of year	Poor turf quality Waste of time and money Kill turf

SCIENCE

Fluids under pressure

Liquid and dry measures
[solubility and miscibility of dry and liquid materials]

Physiological action of fungicide or bactericide on disease

Understand physiology and growth conditions of fungus and bacteria

MATH – NUMBER SYSTEMS

Basic Arithmetic Skills and Concepts (see appendix)

Basic Measurement Skills and Concepts (see appendix)

Determination of area, perimeter and diagonals of polygons with more than four sides

Determination of area, perimeter and diagonals of quadrilaterials (four-sided figures)

Determination of area and volume of cylinders

Read and interpret tables, charts and/or graphs

Given an Instrument of Measure, determine precision and/or accuracy with respect to relative error, significant digits and tolerance

Calculate:
- Amount of chemical needed per unit volume of water
- Amount of chemical needed per unit volume to be covered

COMMUNICATIONS

Read labels on chemical materials

Read charts and tables on mixing and application rates and procedures

(TASK STATEMENT) CONTROL INSECTS AND OTHER PESTS IN TURF

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Hand lens
Microscope
Dry pesticide applicators
Liquid pesticide applicators
Pesticides
Proportioners and nozzles for hose-end applicators
Safety equipment for human protection (goggles, rubber gloves, rubber suit, respirator)
Insect and pest traps

PERFORMANCE KNOWLEDGE

Identify insects and animal pests
Distinguish between different insect damage

Select proper control measures for specific pests
Service, start and operate mechanical pesticide applicator equipment
Clean and store equipment
Store chemicals properly

SAFETY – HAZARD

Hazards: Chemical burn to skin or hands
Gas injury to skin or lungs
Improper application rate or method resulting in damaging side effects
Danger of damage to helpful insects or animals
Danger of air, soil, and water pollution
Safety procedures: Use only "legal" chemicals and read labels
Learn first aid and safe chemical handling
Apply chemicals only in "safe" areas and avoid carelessness
Avoid careless application techniques
Use protective clothing and respiration

DECISIONS	CUES	ERRORS
Determine control measures to be used Select proper mechanical device for pesticide application	Analyze type of pests, type of sod, type of soil Type of control used, manufacturers' suggested application; soil terrain, season of year	Poor turf quality Waste of time and money Kill turf

SCIENCE

Fluids under pressure

Liquid and dry measures
[solubility and miscibility of dry and liquid chemicals]

Chemical action of chemical on the pest
Understand difference between surface and sub-surface pests

MATH – NUMBER SYSTEMS

Basic Arithmetic Skills and Concepts (see appendix)

Basic Measurement Skills and Concepts (see appendix)

Determination of area, perimeter and diagonals of polygons with more than four sides

Determination of area, perimeter and diagonals of quadrilaterals (four-sided figures)

Determination of area and volume of cylinders

Read and interpret tables, charts and/or graphs

Given an Instrument of Measure, determine precision and/or accuracy with respect to relative error, significant digits and tolerance

Calculate:
Chemical needed per unit volume
Amount of chemical to be applied per unit area

COMMUNICATIONS

Read labels on chemical materials

Read charts and tables on mixing and application rates and procedures

(TASK STATEMENT) PRUNE TREES AND SHRUBS ON GOLF COURSE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Trees Shrubs Hand pruners Loppers Shears Tree harness Hard hat Tree ropes Power saw Wood and shrub chipper Tree wrap Tree paint (tar) Saw	Identify shrubs and trees needed pruning Prune shrubs with hand tools Climb trees using tree harness and rope Prune trees using hand saws and power saw	Hazards: Cuts from pruning equipment Danger to eyes Danger of falling or of falling objects Safety precautions: Use protective goggles and clothing Use correct safety harness Do not smoke near power saw or other flammable materials

DECISIONS	CUES	ERRORS
Determine frequency of pruning Determine extent of pruning	Plant needs; growth conditions; season Aesthetics; type of plant; growth cycle; season; reason for pruning	Death of tree Slow growth

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Simple machines used to gain mechanical advantage Work input, work output, friction and efficiency in simple machines Use of leverage with tree ropes		View size and shape of tree and/or shrub

Duty C Selling Sod

1 Identify, Recommend and Procure Turf Grass for Specific Uses
2 Sell Sod
3 Harvest, Load and Deliver Sod for Customers

(TASK STATEMENT) IDENTIFY, RECOMMEND AND PROCURE TURF GRASS FOR SPECIFIC USES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
	Identify species and varieties of turf grasses used for turf in Ohio Identify sources of grass seed, sod, plugs, twigs or stolens Order quality turf grass seed or sod at economical prices	

DECISIONS	CUES	ERRORS
Select the turf grass needed for specific uses	Soil conditions, proposed use of grass area, growth conditions, season, weather	Poor turf quality Slow growth Wasted money

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Turf grass classification Morphology and anatomy of turf grass plant Basic physiological factors of plant growth: Photosynthesis Respiration Translocation Transpiration Germination Effects of environment on plant growth		Write to suppliers of turf grass to receive information about inventories, prices and availability

(TASK STATEMENT) SELL SOD

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Sales invoices Order forms	Identify customer needs and desires Take order for sales by telephone Make cost estimates on orders Write up customer orders Advise customers on establishment and care of sod	

DECISIONS	CUES	ERRORS
Implied–application of procedure		Waste of harvest Inefficient use of time, equipment

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
	Basic Arithmetic Skills and Concepts (see appendix)	Take orders by telephone Make estimates Write orders Advise customers

(TASK STATEMENT) HARVEST, LOAD AND DELIVER SOD FOR CUSTOMERS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Sod cutter Fork lift Pallets Flat bed truck	Lift and roll sod with machine Load sod on trucks Deliver sod to customers Clean and store equipment	Hazards: Back injury to persons loading sod Injury from sod cutter, fork lift or truck

DECISIONS	CUES	ERRORS
Implied–application of procedure		Waste of harvest Inefficient use of time, equipment

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Work input, work output, friction and efficiency in simple machines		Read delivery orders

Duty D Maintaining Tools, Equipment and Structures

1 Clean, paint and sharpen tools
2 Service equipment and vehicles
3 Maintain bridges and buildings

(TASK STATEMENT) CLEAN, PAINT AND SHARPEN TOOLS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Files for sharpening Oil squirt cans Power grinders or polishers Hammer and plyers to straighten tools Scrub brushes Cleaning rags Paints and surfacing materials	Identify proper techniques to clean and sharpen working surfaces Sharpen tools with hand files Sharpen tools with power grinders or polishers Identify treatment of specific tools Apply painting and surfacing techniques	Hazards: Injuries due to careless use of tools Working with tools that are too dull

DECISIONS	CUES	ERRORS
Determine need and frequency of cleaning and sharpening	Type of equipment; frequency of use; manufacturer's suggestions; condition of equipment	Poorly maintained equipment Inefficient use

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Centrifugal forces developed by bodies in rotation [grinding wheels] Effects of friction on work processes and product quality	Count and store tools by storage numbers	Keep tool inventory records

(TASK STATEMENT) SERVICE EQUIPMENT AND VEHICLES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

Mowers
Aerifiers
Dethatchers
Sprayers
Tractors
Pickups, trucks
Golf carts
Sod cutter
Seeders
Power loaders (fork lift)
Gas and oil cans
Grease gun
Calibrator

PERFORMANCE KNOWLEDGE

Determine type of fuel, oil or other material needed to service specific machines
Lubricate, fill gasoline, fill oil chamber and check air in tires
Check electrical system for correct ignition
Start and run various equipment to see if in good working order
Clean and store equipment

SAFETY – HAZARD

Hazards:
- Combustion of flammable materials
- Burning of skin and eyes with chemicals
- Danger of improper starts or starts with equipment in gear

Safety precautions:
- Do not smoke around flammable materials
- Wear protective clothing
- Be sure equipment is disengaged before starting

DECISIONS	CUES	ERRORS
Determine need and frequency of servicing	Type of equipment, frequency of use, manufacturer's suggestions, condition of equipment	Poorly maintained equipment Inefficient use

SCIENCE

Oil and gas mixtures
Electrical system firing
Simple machines used to gain mechanical advantage
Effect of heating and cooling on expansion of materials (change of dimensions)
Centrifugal forces developed by bodies in rotation

MATH – NUMBER SYSTEMS

Measures of weight
Liquid and dry measures
Liquid and volumetric measurements
Calibrate gap in spark plugs

COMMUNICATIONS

Read service manuals

(TASK STATEMENT) MAINTAIN BRIDGES AND BUILDINGS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Scrapers Paint brushes Paint, paint thinner Hammer Nails, screws, etc. Hand saw Buildings Bridges Roofing shingles and tar Ladders	Identify repairs needed on maintenance buildings or bridges Prepare surfaces for painting Paint wood or metal surfaces Repair wooden or metal structures Reshingle and tar roofs	Hazards: Combustion of flammable materials Injury due to falling from bridges or buildings Miscellaneous cuts and bruises from hand tools Safety precautions: Do not smoke near flammable materials Use ladders properly Use hand tools properly

DECISIONS	CUES	ERRORS
Determine need and frequency of maintenance	Type fo buildings, etc., frequency of use, condition of buildings, bridges, etc.	Poorly maintained buildings, bridges, etc. Waste of materials

SCIENCE	MATH – NUMBER SYSTEMS	COMMUNICATIONS
Simple machines used to gain mechanical advantage	Measures of length Liquid and dry measures	Read paint labels Read directions from the supervisor

Basic Arithmetic Skills and Concepts

- Number/numeral/place values
- Addition and subtraction of whole numbers
- Multiplication and division with whole numbers
- Reduction of fractions
- Addition and subtraction of proper and improper fractions
- Multiplication and division of proper and improper fractions
- Changing mixed numbers to improper fractions
- Addition and subtraction of decimal fractions
- Multiplication and division of decimal fractions
- Rounding off decimals and whole numbers
- Changing percents to fractions and fractions to percents
- Finding a percent of a number and what percent one number is of another
- Ratio and proportion
- Property of comparison—equality, inequality, greater than/less than

Basic Measurement Skills and Concepts

- Measure of length
- Measure of time and speed (example: time—seconds, minutes, etc.; speed—feet per minute, R.P.M., etc.)
- Measures of weight
- Measures of temperature
- Liquid and dry measures